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826 7590 11/18/2008

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

EXAMINER

KHUU, HIEN DIEU THI

ART UNIT

PAPER NUMBER

2863

DATE MAILED: 11/18/2008

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/583,807

08/23/2006

Renan Zhou

051866/313463

6875

TITLE OF INVENTION: METHOD AND APPARATUS FOR MEASURING THE RESISTIVITY OF ELECTROMAGNETIC WAVES OF THE EARTH

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	\$755	\$300	\$0	\$1055	02/18/2009

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

826 7590 11/18/2008

**ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000**

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Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/583,807 08/23/2006 Renan Zhou 051866/313463 6875

TITLE OF INVENTION: METHOD AND APPARATUS FOR MEASURING THE RESISTIVITY OF ELECTROMAGNETIC WAVES OF THE EARTH

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
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nonprovisional YES \$755 \$300 \$0 \$1055 02/18/2009

EXAMINER	ART UNIT	CLASS-SUBCLASS
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KHUU, HIEN DIEU THI 2863 702-007000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____
- (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____
- 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s); (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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EXAMINER

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ART UNIT

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Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 333 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 333 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability	Application No.	Applicant(s)	
	10/583,807	ZHOU ET AL.	
	Examiner	Art Unit	
	CINDY H.D.T. KHUU	2863	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 10/17/2008.
2. ☒ The allowed claim(s) is/are 1 and 2.
3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☒ All b) ☐ Some* c) ☐ None of the:
 1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
 - * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☒ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☒ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☒ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) 2. <input checked="" type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) 3. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date <u>10/16/2006;10-27-08</u> 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit of Biological Material | <ol style="list-style-type: none"> 5. <input type="checkbox"/> Notice of Informal Patent Application 6. <input type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date _____. 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance 9. <input type="checkbox"/> Other _____. |
|---|---|

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DETAILED ACTION

Drawing Objection

Figure 3 is objected by Draftsperson's Review. Please see attached PTO-948 form.

Examiner's Amendment

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given by Mr. Cory C. Davis during a telephone interview on 10/27/2008.

This application is in condition for allowance except for the presence of claims 3-8 are non-elected without traverse. Accordingly, claims 3-8 have been cancelled.

The application has been amended as follows:

Replace Abstract as follows:

-- A method for measuring electromagnetic wave resistivity of earth formations is provided. The method uses electric field and magnetic field sensors in conjunction with a data collecting system to obtain data samples from strata, determine certain parameters associated with the data samples, such as a depth coefficient and a surface-layer depth coefficient, establish an observational reference frame based upon an equation defined by the stratum depth (H) and propagation frequency (F) and an equation defined by the electromagnetic wave resistivity (ρ) and stratum depth (H), and utilizes the reference frame to record results from a system configured for continuously measuring the electromagnetic wave resistivity of earth formations. The method uses actual data to determine the relationship between the stratum depth (H) and propagation frequency (F), which makes the resistivity of earth formations the only variable to be measured and thus significantly improves the accuracy of depth measurements. --

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Amend Claim 1 starting with page 18, step 5, and lines 1-9 as follows:

-- A method for measuring resistivity of electromagnetic waves of the earth, comprising:

(1) establishing a linear coordinate system for observation and presetting initial parameters for capturing data, wherein, said linear coordinate system is based on an equation between a propagation frequency (F) and a stratum depth (H), said equation being $F=a+bK'/H$, wherein, F is the propagation frequency and its unit is Hz, H is the strata depth and its unit is meter, a is a surface-layer coefficient having a small and neglectable value, b is a coefficient in regional stratum resistivity varied with the stratum depth, having a value of 0.1, K' is a measured depth that is defined during the propagation of the electromagnetic wave in the strata, wherein, said initial parameters include a measurement starting depth (H 1), a measurement ending depth (H2), and a sampling interval value (S);

(2) determining a depth coefficient (B) via the steps of: (a) selecting a known drilling well in a region to be measured or a region adjacent to said region to be measured; (b) performing exploration and measurement around said known drilling well to obtain a curve of electromagnetic wave resistivity; (c) comparing said curve obtained in step (b) with a curve of the electromagnetic wave resistivity of the known drilling well to determine said depth coefficient (B), wherein said comparing further comprises: i. selecting a segment from said curve obtained in (b) and comparing with a corresponding segment of said curve of the electromagnetic wave resistivity of the known drilling well; ii. determining a sampling interval S' using an equation of $S'=(H_{p2}-H_{p1})/(L2-L1)$, wherein, H_{p1} is a depth of a characteristic point of a first well logging curve of the known drilling well and its unit is meter, H_{p2} is a depth of a characteristic point of a second well logging curve of the known drilling well and its unit is meter, L1 is the number of a collection point of a newly measured curve of the electromagnetic wave resistivity which has similar characteristics as that of the characteristic point of the curve of the first well logging, and L2 is the number of a collection point of a newly measured curve of the electromagnetic wave resistivity which has similar characteristics as that of the characteristic point of the curve of the second well logging; and iii. responsive to the determination, determining said depth coefficient (B) through equations of (a) $E=S'/S$ and (b) $B=EbK'$, wherein, B is used to substitute the value of bK' in said equation of $F=a+bK'/H$, thereby resulting in an equation of $H=BT$, wherein T is a period and its unit is microsecond, wherein B is in a range of 0.001-1.000;

(3) calibrating a surface-layer depth coefficient (Ha) through the steps of: (a) comparing said curve obtained in step (2)(b) with said curve of the electromagnetic wave resistivity of the known drilling well in respective segments to obtain a value of system error of depths at each characteristic point, said value of system error being $H_a=H_d-H_c$, wherein, H_a is a surface-layer depth coefficient, H_d is a depth of the characteristic point of electrical well logging of the known drilling well, and H_c is a depth of said characteristic point of the electromagnetic wave resistivity curve; and (b) using said surface-layer depth coefficient H_a to calibrate a surface-layer depth for a measured depth using the curve of the electromagnetic wave resistivity, wherein the calibrated measurement starting depth is: $H_{lj}=H_1+H_a$;

(4) determining other parameters through the steps of: (a) determining a measurement starting depth or a measurement ending depth for data capturing purposes based on pre-specified needs; (b) selecting a number of sampling intervals depending on different conditions including: i. for comparing different regional strata and tracking electrical interfaces of different, 5 meter, 10 meter or 20 meter being selected as said sampling intervals; and ii. for tracking and detecting ore bed such as oil bed, coal bed and metal ore bed or a crack band, 0.2 meter, 0.5 meter or 1 meter being selected as said sampling intervals; wherein, a number of sampling points can be determined depending on different conditions including: i. taking 8 points when the finishing depth is less than or equal to 1000 meter; ii. taking 16 points when the finishing depth is less than or equal to 2000 meter; iii. taking 32 points when the finishing depth is less than or equal to 4000 meter; and iv. taking 64 points when the finishing depth is less than or equal to 8000 meter; wherein, the corresponding sampling periods being 128, 64, 32 and 16 respectively; (c) determining a channel gain by selecting the first channel (CH 1) and second channel (CH2) when a double sensor is used, and selecting the first to eighth channels (CH1-

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CH8) while a multi sensor is used; (d) providing a lowpass filter by using an automatic tracing filter in shallow strata or where there is strong industrial power supply interference; and

(5) determining whether data captured through the steps (1) to (4) meets a quality standard required of original data, and responsive to the determination that the standard is met, recording said data in a data capturing, controlling and processing system, wherein said system is configured to:

(a) receive said measurement starting depth and said sampling intervals determined through the steps (1) to (4), and establish a relation of the strata depth and the period by said equation $H=BT$;

(b) collect data of an electric field intensity and data of a magnetic field intensity at different strata depths by continuously changing the frequency, and establishing a relation between the electric field intensity and the strata depth and a relation between the magnetic field intensity and the strata depth;

(c) establish a relation between the electromagnetic wave resistivity and the strata depth by means of the relation between the electric field intensity and the strata depth, the relation between the magnetic field intensity and the strata depth, and a relation among the electromagnetic wave resistivity, the electric field intensity, and the magnetic field intensity;

~~(b) determining~~ (d) determine proportions of a vertical coordinate with respect to a horizontal coordinate at an interface of said linear coordinate system for observation in which the vertical coordinate represents the electromagnetic wave resistivity and the horizontal coordinate represents the strata depth; and

~~(e) processing said data to~~ (e) produce a result graph containing data results according to the relation between the electromagnetic wave resistivity and the strata depth. --

Pertinent Art Cited

The following US Patent Applications reveal the current state of the art:

Smith (US 6,114,972) teaches of a method for measuring resistivity of electromagnetic waves of the earth (abstract, lines 1-5), comprising:

transmitting electromagnetic waves into the earth surrounding the wellbore;

measuring the current draw by the electromagnetic transmitter;

determining the resistivity of the earth surrounding the wellbore based upon the current draw; and

comparing the resistivity of the earth surrounding the wellbore with known resistivity to determine the position of the downhole tool in the wellbore (claim 1).

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However, Smith does not teach at least establishing a linear coordinate system wherein said linear coordinate system is based on an equation between a propagation frequency and a stratum depth, said equation being $F=a+bK'/H$; determining a depth coefficient; calibrating a surface-layer depth coefficient; and determining proportions of a vertical coordinate with respect to a horizontal coordinate at an interface of said linear coordinate system.

Meador et al. (US 4,107,597) teaches of a method for measuring resistivity of electromagnetic waves of the earth (column 1, lines 50-70), comprising:

- generating a electromagnetic field frequency range 800khz to 4mhz in borehole;
- detecting electromagnetic field at a plurality of longitudinally spaced locations;
- measuring the attenuation and propagation velocity of the electromagnetic wave at the longitudinally spaced receivers according to predetermined relationships in terms of the formation resistivity, flushed zone resistivity and invasion diameter surrounding the borehole (abstract).

However, Meador does not teach at least establishing a linear coordinate system wherein said linear coordinate system is based on an equation between a propagation frequency and a stratum depth, said equation being $F=a+bK'/H$; determining a depth coefficient; calibrating a surface-layer depth coefficient; and determining proportions of a vertical coordinate with respect to a horizontal coordinate at an interface of said linear coordinate system.

Allowable Subject Matter

Claims 1-2 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

The primary reason for the allowance of claim 1 is the inclusion of the limitation “establishing a linear coordinate system wherein said linear coordinate system is based on an equation between a propagation frequency and a stratum depth, said equation being $F=a+bK'/H$; determining a depth coefficient; calibrating a surface-layer depth coefficient; and determining

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proportions of a vertical coordinate with respect to a horizontal coordinate at an interface of said linear coordinate system". The prior art of record, taken alone or in combination, fails to disclose or render obvious.

Claim 2 are allowed due to their dependency on claim 1.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Fax/Telephone Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Cindy D. Khuu whose telephone number is (571) 272-8585. The examiner can normally be reached on M-F, 7:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Dunn can be reached on (571) 272-2312. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/chk/
11/10/2008

/Michael P. Nghiem/
Primary Examiner, GAU 2863